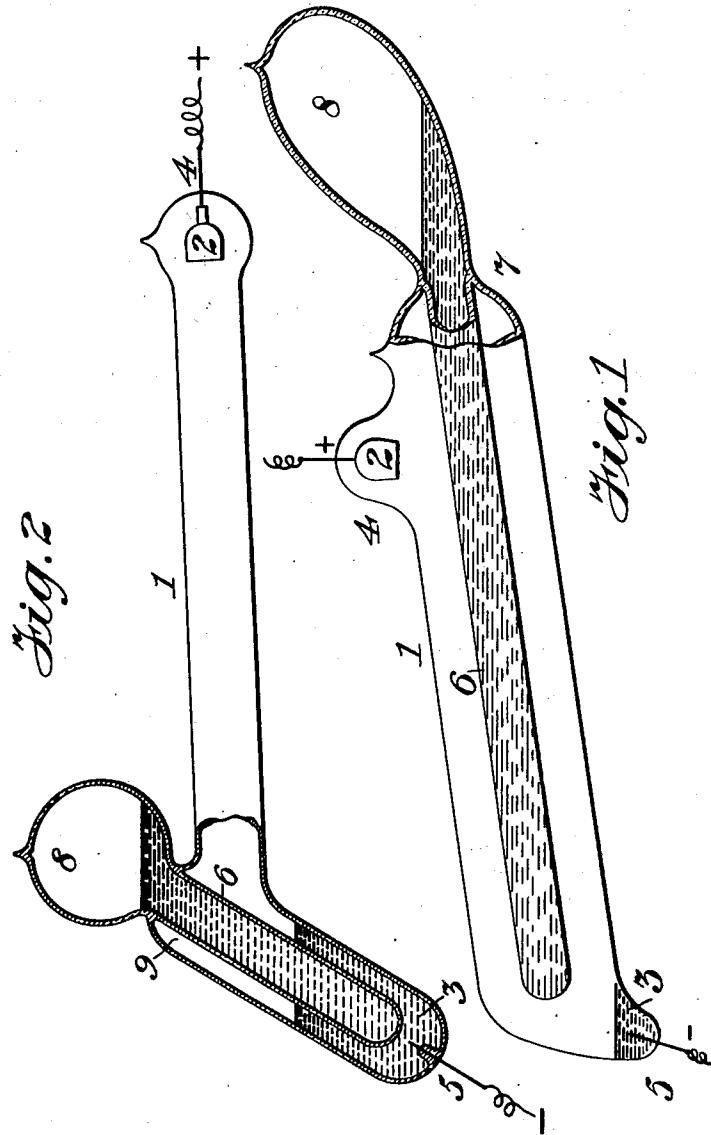


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METHOD OF COOLING VAPOR ELECTRIC APPARATUS.
APPLICATION FILED MAR. 28, 1904.

1,048,762.

Patented Dec. 31, 1912.



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METHOD OF COOLING VAPOR ELECTRIC APPARATUS.

1,048,762.

Specification of Letters Patent.

Patented Dec. 31, 1912.

Application filed March 28, 1904. Serial No. 200,284.

To all whom it may concern:

Be it known that I, PERCY H. THOMAS, a citizen of the United States, and resident of East Orange, county of Essex, State of New Jersey, have invented certain new and useful Improvements in Methods of Cooling Vapor Electric Apparatus, of which the following is a specification.

In the operation of gas or vapor electric apparatus it is often desirable to produce a local cooling of some portions of the apparatus for various purposes. It may be desired, for example, to run the disintegrating negative electrode in apparatus of this class comparatively cool so as to keep down the development of vapor from the electrode to comparatively low limits. Moreover, either in combination with such means for cooling the negative electrode, or independently thereof, it may be desired to produce local cooling in the vapor path whereby an excess of vapor in the light-giving portion of the apparatus is prevented. This latter function of cooling means applied to a vapor apparatus may become especially valuable in vapor lamps wherein a mixture of gases or vapors is employed, one or more being condensable and the other or others being comparatively non-condensable. In such cases a portion of the apparatus may be cooled so as to keep down the excess of condensable vapor, but in practice, where such cooling is done at a portion of the apparatus remote from the light-giving portion any excess of condensable gas which has escaped from the cooling means into the light-giving portion will gradually accumulate and by reason of the high temperature of this portion of the apparatus may not be readily condensed. Under such circumstances a return path may be provided for the excess of vapor, but this is found to be somewhat cumbersome, and it is generally preferred that other means for condensing the vapor should be employed, such, for example, as means for local artificial condensation. The local condensation might be accomplished by using a water or other cooling jacket outside the tube. This, however, would be open to the objection of the additional weight and bulk of the apparatus, while it is also true that a portion of the light-energy would be absorbed in passing

through the walls of the jacket and the fluid therein.

It is a part of the present invention to secure the benefits of artificial cooling without the disadvantages due to a return tube or an external water jacket, at the same time providing ready means for dissipating the heat accumulated in the gas path in a simple and convenient manner.

A still further object of the invention is that of insuring that every portion of the light-giving vapor should be able to deliver up its heat by reason of the fact that an intimate contact is provided between the vapor and the cooling means. I accomplish these results by providing in the interior of the chamber of the apparatus, throughout the whole or a portion of the light-giving path, an inner tube sealed off from the main vacuum chamber and containing a suitable heat conducting fluid, such as alcohol, ether, water, or other suitable material.

When an apparatus is constructed embodying the features above described and in the manner herein illustrated, the cooling means may be maintained at a constant temperature regardless of atmospheric variations. By employing within the inner tube a liquid having a definite boiling point and determining the gas pressure upon its surface and by providing an independent condensing chamber for the cooling liquid, I may bring about a condition in which, upon the starting of the apparatus, heat will accumulate in the liquid until it reaches its boiling point, above which no elevation of temperature can take place until the liquid is entirely vaporized. Owing, however, to the presence of the special condensing chamber above referred to, the vapor from the cooling liquid is cooled and condensed and then drains back to replenish the supply of liquid.

In the accompanying drawings, Figure 1 shows an apparatus in which the cooling means are applied internally along the greater portion of the vapor column; and Fig. 2 shows a similar apparatus in which the negative electrode itself as well as a portion of the vapor is subjected to the influence of the cooling means.

Referring to the first figure of the draw-

ings, 1 is a container of glass or other suitable material and 2 and 3 are, respectively, the positive and negative electrodes of the apparatus, the same being connected with lead-wires, 4 and 5. In this instance the negative electrode 3 may be assumed to be of mercury and the positive electrode 2 of iron or other suitable solid material. Through the major portion of the container 1 is run a tube, 6, which is sealed off from the container 1 at the point 7. This tube 6 is provided with a condensing chamber, 8, and is partially filled with alcohol, ether, water, or some other suitable material. The liquid in the tube 6 will have a definite boiling point depending upon the gas pressure upon its surface, which pressure can be predetermined before sealing off the condensing chamber 8. The vapor developed in the operation of the apparatus, considered as a whole, will, under the conditions described, be mercury vapor, but we may assume that some other gas or vapor, such as nitrogen, or carbonic acid gas, is introduced in definite quantity into the container 1 so as to affect in a desirable manner the total spectrum given out by the apparatus when current is passed through it. Under these conditions, it is generally desirable to cut down the amount of mercury vapor in the light-giving portion of the apparatus, owing to the tendency of such vapor to be developed in excess. The liquid containing tube 6 serves this purpose, while by reason of its location it does not notably absorb the light-energy of the apparatus, whereby the efficiency of the same is maintained practically undiminished. The liquid in the tube 6 having been brought to a state of boiling, the vapors arising from it ascend in the chamber 8 and are there condensed and fall back again to replenish the liquid. Manifestly, the cooling means thus described are independent of atmospheric conditions or variations. By properly proportioning the parts, the excess of mercury vapor can be kept down to appropriate limits so that the apparatus as a whole will produce a predetermined spectrum. The same would apply to other condensable vapors besides mercury vapor, and the conditions would not be essentially altered by substituting for the nitrogen or carbonic acid gas any other suitable gas whose spectrum contained the desirable rays. Practically the whole of the vapor in the light-giving portion of the tube is subjected in the form of apparatus illustrated in Fig. 1 to the effects of the cooling means.

In Fig. 2, the container is again shown at 1, the positive electrode at 2, the negative electrode at 3, and the lead-wires at 4 and 5. Here, however, the tube 6 does not extend through the greater portion of the light-giving column but is sealed into the extension, 9, of the receptacle containing the nega-

tive electrode 3. The conditions in other respects are substantially the same as those already described. It is to be noted, however, that the tube then enters the mercury electrode itself and that by so doing it exposes the latter to cooling influences and also constricts the surface of mercury which is exposed to evaporation. The mercury vapor, however, as soon as it is liberated, is at once exposed to the influence of cooling means and thereby the tendency to excessive development of vapor is prevented. Under these conditions the mercury electrode might run comparatively cool, a condition which under some circumstances is desirable.

In a divisional application filed June 14, 1904, Serial Number 212,475, claims are made upon the apparatus disclosed in this application. In a divisional application filed April 27th, 1912, Serial Number 693,564, claims are made upon certain features of the apparatus described herein.

I claim as my invention:—

1. In a vacuum vapor electric apparatus adapted to produce light, the method of controlling the spectrum of emitted light, which consists in passing electric current through the apparatus by the production of vapor therein, adding a permanent gas adapted in character to supplement the spectrum of the vapor, but insufficient in quantity to balance the total quantity of vapor naturally produced and removing the natural excess of vapor by maintaining the vapor path in the light giving portion at a temperature below the natural temperature and corresponding to the pressure of the vapor when not in excess.

2. In a vacuum vapor electric apparatus adapted to produce light the method of controlling the spectrum of emitted light which consists in passing electric current through the apparatus by the production of vapor therein, adding a permanent gas adapted in character to supplement the spectrum of the vapor, but insufficient in quantity to balance the total quantity of vapor naturally produced and removing the natural excess of vapor by maintaining all parts of the light giving portion, symmetrically and without obstruction to the emission of light, at a temperature below the natural temperature and corresponding to the pressure of the vapor when not in excess.

3. In a gas or vapor electric lamp having an exhausted container and suitable electrodes therein at least one of which is of vaporizable material, the method of producing a predetermined spectrum which consists in passing current through said lamp thereby generating vapor from the vaporizable electrode, projecting said vapor into the path of said current, adding thereto a relatively noncondensable gas forming in conjunction with the said vapor at normal

pressure the desired spectrum, producing an excess of said vapor and condensing said excess out of the space normally traversed by light radiations.

5 4. In a gas or vapor electric lamp having an exhausted container and suitable electrodes therein at least one of which is of vaporizable material, the method of producing a predetermined spectrum, which
10 consists in passing current through said lamp thereby generating vapor from the vaporizable electrode, projecting said vapor into the path of said current, adding thereto a relatively noncondensable gas forming in
15 conjunction with the said vapor at normal pressure the desired spectrum, producing an excess of said vapor and condensing said excess out of the space normally traversed by light radiations, the excess of said vapor
20 being determined by the vaporizing point of a suitable liquid.

5 In a gas or vapor electric lamp having an exhausted container and suitable electrodes therein at least one of which is of
25 vaporizable material, the method of producing a predetermined spectrum, which consists in passing current through said lamp thereby generating vapor from the vaporizable electrode, projecting said vapor
30 into the path of said current, adding thereto a relatively noncondensable gas forming in conjunction with the said vapor at normal pressure the desired spectrum, producing an excess of said vapor and condensing
35 said excess out of the space normally traversed by light radiations, the excess of said vapor being determined by the vaporizing point of a suitable liquid and by controlling said vaporization point by subjecting it to
40 a suitable gas pressure.

6. In a vapor electric apparatus, the combination with a gas giving an incomplete spectrum, of a natural excess of a condensable gas or vapor above the proper quantity
45 to give the desired spectrum, and means for removing the excess from the light-giving portion, such means consisting of a cooling device arranged in the interior of the gas column.

50 7. In a vapor electric lamp, the combination with a mixture of gases having definite spectrums, at least one of the gases being condensable, of means for preventing the domination of the condensable gas, such

means consisting of a tube extending through 55 the vapor path and containing a suitable liquid.

8. A combination with a tubular vapor container with a cylindrical light giving portion and an electrode of vaporizable material therein, of a cooling means including
60 an internal axially located tube in the said cylindrical portion closed from the said container and cooling means therein.

9. A combination with a tubular vapor 65 container with a cylindrical light giving portion and an electrode of vaporizable material therein, of a cooling means including an internal axially located tube in the said cylindrical portion closed from the said container and forming a second chamber with
70 a cooling portion outside said vapor container.

10. A combination with a tubular vapor container with a cylindrical light giving 75 portion and an electrode of vaporizable material therein, of a cooling means including an internal axially located tube in the said cylindrical portion, closed from the said container and forming a second chamber
80 with a cooling portion outside said vapor container together with a vaporizable liquid within the axial tube adapted to absorb heat within the container and deliver heat outside said container.
85

11. A combination with a tubular vapor container with a cylindrical light giving portion and an electrode of vaporizable material therein, of a cooling means including
90 an internal axially located tube in the said cylindrical portion, closed from the said container and forming a second chamber with a cooling portion outside said vapor container together with a vaporizable liquid within the axial tube adapted to absorb heat
95 within the container and deliver heat outside said container, the proportions of the parts being such as to give a suitable pressure of the condensable vapor within the main container.
100

Signed at New York in the county of New York and State of New York this 21st day of March A. D. 1904.

PERCY H. THOMAS.

Witnesses:

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